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REVIEW PAPER

The Influence of Therapeutic Massage on Muscle Recovery, Physiological, Psychological and Performance in Sport: A Systematic Review

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Abstract

This study aims to identify the effects of therapeutic massage on muscle recovery, physiological, psychological and performance in sport. Articles were identified from several databases by searching MEDLINE, Embase, CINAHL, PEDro, Web of Science, Scopus, Google Scholar, and PubMed starting from 2010 to 2023, related through databases according to predefined inclusion criteria that were identified previously. In the review, 31 studies were considered to be eligible for inclusion by recruiting male (n=558) participants, aged between 12 and 60 years, and females (n=226) participants, aged between 12 and 60 years. Compared with the active control, twelve studies found massage to have a significant and measurable benefit, whereas five studies found no obvious advantage. Comparing massage with an inactive control, four studies reported massage to have a significant and considerable effect, whereas three studies did not. For massage compared with other therapies, three studies reported massage to have a measurable and considerable effect, whereas two studies did not. Massage as a stand-alone treatment provided a considerable and substantial benefit in two studies, whereas one study found no significant impact on muscle healing, performance, physiological, and psychological. In conclusion, the current study revealed that massage had a large and substantial advantage when compared with an inactive and active control, but not when compared with other interventions, as examined in this review. There was a shred of conflicting evidence to prove the superior outcomes of massage when administered as a stand-alone treatment and relative to other forms of therapies. However, the efficiency of massage is rarely assessed.

Keywords: *massage, endurance, musculoskeletal health, confidence, performance, delayed onset muscle soreness*

Introduction

Therapeutic massage is described as the intentional and structured handling of soft tissue for therapy, with the goals of preventing or reducing pain, spasms, tension, or stress and promoting health and wellness (Bervoets et al., 2015). Studies have reported that massage is effective when the noxious stimuli are obstructed, a practice that is in harmony with the gate-control theory (Bender, da Luz, Feldkircher, & Nunes, 2019), thereby increasing the flow of blood and lymphatic system, which is likely to quicken the removal of catabolites and the excretion of endorphins, which is responsible for the promotion of a feeling and sense of wellness in the recipient (Mancinelli et al., 2006; Poppendieck et al., 2016).

Massage techniques such as friction, petrissage, effleurage, vibration, and tapotement are frequently used to treat ailments (Guo et al., 2021). Massage is also used to relieve sore muscles, increase local circulation (Angelov, Gotova, Albert, & Tishinov, 2019; Wiewelhove et al., 2022), loosen muscle spasms and adhesions (McKechnie, Young, & Behm, 2007), rekindle Golgi tendon organs and muscle spindles

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(Wiewelhove et al., 2022), and reduce local inflammatory responses (Bervoets et al., 2015).

Massage is frequently utilised in sports to enhance pain relief and avoid delayed-onset muscular soreness following physical activity (Kheyruri, Sarrafzadeh, Hosseini, Abiri, & Vafa, 2021; Paul et al., 2021). Although massage may be beneficial for athlete rehabilitation, there is little data to support its use in clinical practise for sports (Weerapong, Hume, & Kolt, 2005; Paul et al., 2021). Current research conducted using 22 randomised papers with the aid of meta-analysis postulated that massage has little and flexible results on recovery after exercise (Davis, Alabed, & Chico, 2020). These include system or methods of employing approaches that are non-manual, such as vibration or water-jet massage, which are uncommon, whereas other important factors or variables such as anxiety, stress, and depression are left uninvestigated.

In clinical practise, massage is used to help athletes recuperate from less taxing activities such as competitive jogging and soccer (Andersen et al., 2013). A previous study found that massage alleviated acute discomfort and tiredness in the quadriceps of triathletes following a long-distance Ironman event (Nunes et al., 2016). However, most of the research that examines the effect that massage has on athletes for the sake of recovery has adopted the intervention approach in cases of extreme necessity, which in any case does not show the average condition of most athletes in most sports (Ogai, Yamane, Matsumoto, & Kosaka, 2008). To date, there is a dearth of literature evaluating the effects of massage on athlete recovery at the end of an exercise or sporting game that does not involve a high level of depression, fatigue, anxiety, and stress and may not cause muscle soreness.

Nevertheless, questions remain about massage and its effects, especially as numerous elite athletes consider massage to be an integral component of their success (Gasibat & Suwehli, 2017). Practitioners perform massage at the site of the injury because they anticipate that massage will increase blood flow to the area of the injury and, as a result, aid in healing and recovery (Duñabeitia et al., 2022). For realigning the fibres, massage mechanical pressure is usually adopted to cure adherent or knotted connective tissue (Galloway & Watt, 2004). However, there is little to no empirical study that provides support for this argument.

In recent years, a novel technique combining pressure, vibration, and movement has been developed: percussive massage (Barcala-Furelos, Abelairas-Gomez, Romo-Perez, & Palacios-Aguilar, 2013; Rey, Padrón-Cabo, Costa, & Barcala-Furelos, 2019). This treatment is administered using a therapeutic gun that can be controlled in terms of vibration and allows for simple application over the body (Cullen et al., 2021). With the increase in muscle tone regulation and the flow of blood, it is argued that the combination of vibration and pressure over the tissues has a great influence on the autonomic nervous system (Beardsley & Škarabot, 2015; Behm & Wilke, 2019; Behm et al., 2020). Moreover, because it is assumed that massage may aid in improving recuperation and preparing athletes for upcoming competitions, it is frequently administered between tournaments. However, the effects of massage on recuperation have not yet been thoroughly studied, and there is scant scientific evidence to support these claims (Konrad, Nakamura, Bernsteiner, & Tilp, 2021: Lakhwani & Phansopkar, 2021).

According to Isar, Halim, and Ong (2020), and Moran, Hauth, and Rabena (2018), before exercise or competition, coaches and sports scientists collaborate to provide warmups and performance enhancement. Meanwhile, Bell (2008), and Zainuddin, Newton, Sacco, and Nosaka, (2005) asserted that most athletes termed it a tiresome process of reducing force production. Muscle fibre modifications that reflect the increased effort necessary to maintain a certain level of mechanical performance are related to fatigue (Correa et al., 2012). This decrease in strength may be detrimental to the future performance of elite athletes (Nédélec et al., 2013). In addition to other aspects of performance, such as range of motion, in which the athlete must compete at an elite level, strength is only one component of performance (Phillips, Diggin, King, & Sforzo, 2021). When delayed-onset muscle pain develops, the affected muscles frequently contract, resulting in a restricted range of motion (Su et al., 2017). Massage is believed to help lengthen muscles and increase their pliability, thus allowing for a greater range of motion and enhancing the performance of the body (Davis et al., 2020). Because of the absence of well-conducted studies, the effects of massage on performance have not yet been established.

Athletes in the public spotlight for mental health concerns such as depression, anxiety, and stress have negative consequences on athletic performance by impairing the capacity to concentrate and focus, primarily because of psychological symptoms that cause distraction (Rathod, PS, Sahana, & Rathod, 2021). Psychological elements also have a significant influence on performance determination (Zadkhosh, Ariaee, Atri, Rashidlamir, & Saadatyar, 2015). However, every athlete needs a certain level of stress to perform optimally (Brilian, Ugelta, & Pitriani, 2021). As in other aspects of life, stress in sports may be acute, episodic, or persistent (Brilian et al., 2021). It is typically episodic in sports, whether during a friendly competition or a championship game (Ardern, Taylor, Feller, & Webster, 2013). While acute stress might be a challenge, if left unchecked, it can become not only an episodic stressor with long-term effects but also a hindrance to one's play (Strehli et al., 2021). Hemmings, Smith, Graydon, and Dyson (2000) claimed that rather than being physiological, the effects of sports massage are primarily psychological. Therefore, the initial feeling of recovery following a massage may be the result of these psychological effects, which could have a positive impact on recovery and subsequent levels of performance. Reduced depression, anxiety, and stress may be attributable to a sense of comfort experienced in the process of massage; however, the biological mechanism underlying the effects of massage on the physiological and psychological aspects of the body has not yet been fully elucidated. Existing research has primarily focused on specific aspects, such as pain relief or the psychological benefits of massage, while overlooking a holistic examination of its impact on athletes (Strehli et al., 2021). While traditional massage techniques and their effects have been explored to some extent, emerging modalities such as percussive massage have received limited empirical attention (Konrad et al., 2021). The introduction of percussive massage, which combines pressure, vibration, and movement, introduces a novel therapeutic approach that may have unique effects on the autonomic nervous system and muscle recovery. (Davis et al., 2020). The purpose of this systematic review is to determine the influence of therapeutic massage on muscle recovery, physiological, psychological, and performance in sport due to a dearth of research on this topic.

Materials and Methods

Registration and Ethics

This systematic review was registered on PROSPERO (ID: CRD42022364318) and conducted according to the PRISMA guidelines. The results of this review will be disseminated through peer-reviewed publications. Because all the data used in this systematic review have been published, this review does not require ethical approval.

Study selection process and identification

By searching through online databases between 2010 and 2023, suitable articles were identified. These databases included: MEDLINE, PEDro, PubMed, Google Scholar, Embase, Web of Science, Scopus, and CINAHL with the aid of key words such as: ("Vigour "OR" Massage" OR "Pain "OR "Isometric Strength" OR "Sport" OR "Recreational Athletes" OR "Pressure Pain Threshold" OR "Confusion" OR "Sports Massage" OR "Muscle Function" OR "Recovery" OR "Jump" OR "Pain Behaviour" OR "Cardiovascular Performance" OR "Agility" OR "Delayed Onset Muscle Soreness" OR "Muscle Damage" OR "Squat Jump Sitting" AND "Lying Flexibility" OR "Swelling" OR "Performance" OR "Grip Strength" OR "Endurance" OR "Range of Motion" OR "Sprint Performance" OR "Depression" OR "Anxiety" OR "Stress" OR "Confidence" OR "Mood" OR "Tension" OR "Gait" OR "Physical Fitness" OR "Plasma Creatine Kinase" OR "Blood Pressure" OR "Heart Rate Variability" OR "Blood Lactate" OR "Anger" AND "Hostility" OR "Elite Athletes" OR "Perceived Fatigue" AND "Muscle Stiffness"). The studies were conducted entirely in English. Relevant published literature was also searched through an electronic medium to be checked for any potentiality as located by the references of the systematic view. A single intervention, the experimental design that evaluated the effect of any type of therapeutic massage, compared with no therapy or other therapies in sport, has been published (during, or after training, exercise or competition). The selection was performed independently by four reviewers (QG and MA). First, the titles and abstracts were reviewed for eligibility. The full-text papers were then separately vetted for inclusion. Disagreements among the authors were resolved in the form of dialogue or with the help of the author (AR).

Participants

For recreational athletes, elite athletes, or normal participants, the effects of massage on parameters were assessed (before, during, or after training, exercises, or competition etc.). Participants were aged over 12 years without nationality, gender, and economic level, race, or severity constraints.

Experimental intervention

The interventions within the experimental group consisted of any type of massage therapy such as effleurage, friction, petrissage, and pressing. There were no restrictions on the massage methods, duration, frequency, or measurement instruments.

Control interventions

The interventions of the control group involved a therapy other than massage (e.g., medication, placebo, routine care, etc.).

Eligibility Criteria

In the assessment of study eligibility, the following PICOS criteria were employed: P: Participants: The effects of massage on various parameters were evaluated for individuals categorised as recreational athletes, elite athletes, or normal participants. The assessment encompassed individuals aged over 12 years, without imposing constraints based on nationality, gender, economic level, race, or severity. The evaluation considered the impact of massage before, during, or after training, exercises, or competition. I: Intervention: The experimental group received various massage therapies, including but not limited to effleurage, friction, petrissage, and pressing. There were no restrictions on the methods, duration, frequency, or measurement instruments associated with the massages administered. C: Comparator: The control group received therapies other than massage, such as medication, placebo, and routine care. O: Outcome: The study considered at least one measure to assess pain, disability, perceived fatigue, performance, or endurance. S: Study Design: The inclusion criteria comprised experimental study designs, encompassing both randomised and non-randomised controlled trials.

Data Extraction

Relevant data from all included studies were extracted, encompassing sample characteristics, interventions in different groups, and a detailed examination of massage techniques, doses, durations, and their effects. The discussion of outcomes included relevant metrics related to pain, disability, perceived fatigue, performance, and endurance. The focus remained on publications featuring a singular intervention, employing an experimental design that evaluated the effects of any therapeutic massage type compared with either no therapy or alternative therapies in the context of sports, whether administered during or after training, exercise, or competition. In cases where additional information was required, emails were dispatched to the corresponding authors of the included research for clarification.

Quality Assessment

Using the PEDro scale, we evaluated the methodological quality of the trials and selected papers (de Morton, 2009). Eleven items on the PEDro scale evaluate four fundamental methodological features of a study, including randomization, blinding techniques, group comparison, and data analysis processes. Two independent raters assessed the quality of trials in the PEDro database, and conflicts were settled by a third rater (Lucas et al., 2019). Item 1 (eligibility criteria) was not included in the overall score because it had no bearing on the internal or statistical validity of the research. PEDro scores vary from 0 to 10 (Moseley, Herbert, Sherrington, & Maher, 2002). The quality of a procedure is proportional to its PEDro score. Using the following criteria, the quality of the approach is evaluated: a PEDro score below 5 denotes poor quality, whereas a score above 5 suggests outstanding quality (de Morton, 2009; Table 1).

Data Syntheses and Analysis

This research is a synthesis of both quantitative and qualitative data meta-aggregation. Best evidence synthesis, also known as best evidence synthesis, was used to evaluate the weight of scientific evidence (Cruz-Ferreira et al., 2011). This rating system takes into account the quantity of studies, the quality of the methodologies used in those studies, and the consistency of the results across all five levels of evidence: (1) strong evidence, which is provided by generally consistent findings in multiple (at least two) high quality studies; (2) moderate evidence, which is provided by generally consistent findings in one high quality study and one or more low-quality studies or in multiple low-quality studies; (3) limited evidence, which is provided when only one study is available or when findings are inconsistent in multiple (at least two) studies; and (4) conflicting evidence, which is provided by conflicting findings in case–control studies that have been found (Burns, Rohrich, & Chung, 2011).

Results

Flow of studies through the review

The preliminary search yielded 16,300 results. Following the removal of duplicates, only 1,520 unique hits were saved for further analysis. The titles and abstracts of 1,480 records were used to exclude them, and 40 papers were evaluated to determine eligibility. 31 papers were acceptable for inclusion in the current analysis, while nine were eliminated (Figure 1).

Description of the studies

All selected studies were published in the English language. The design of the studies was systematically reviewed as follows: Randomised controlled trial (n=14), repeated measures design experiment (n=5), Individualised design (n=2), classical experimental design (n=1), randomised crossover design (n=6), quasi-experimental design (n=2) and an experimental study were conducted using a similar subject design (treated by subject design) (n=1). The distribution of publication countries was as follows: United States (n=4), United Kingdom (n=2), Canada (n=4), India (n=2), Iran (n=4), Turkey (n=2), China (n=1), Syria and Lebanon (n=1), Singapore (n=1), Brazil (n=2), Korea (n=2), Australia (n=1), Spain (n=2), Thailand (n=1), Indonesia (n=1), and Poland (n=1). The most important output of the studies is shown in Table 2.

Methodical Quality

On the PEDro scale, the values ranged from 0 to 5. It appears that there was a mixture of high-quality and low-quality research because there were 2 studies that scored less than 5 while the others (n=29) scored 5 or higher. There was no correlation between the year of publication and the quality of the studies because the studies of the lowest quality were published in 2010, whereas the studies of the highest quality were published between 2011 and 2022 (Table 1). Eligibility criteria (n=31), group similarity at baseline (n=29), point measure and variability (n=28), random allocation (n=29), between-group comparisons (n=29), and follow-up (n=31) were met most of the time. The criteria of a blind subject or therapist were not satisfied in any of the studies that were analysed; however, the criterion of a blind assessor was satisfied in two of those studies: concealed allocation (n=5) and intention-to-treat analysis (n=27; Table 1).

Participants

The sample size among the studies consisted of males (n=558, participants) aged between 12 and 60 years and females (n=226, participants), aged between 12 and 60 years. Overall, only 19 studies included athlete participants, and seven studies included recreational athletes. Six studies included normal participants. The effects of massage on the parameters of these subjects were investigated after receiving exercise sessions.

Interventions

Several massage methods of wide variety, frequency, and duration were adopted in the current study. The massage therapies included sports massage (n=5), Thai massage (n=1), Swedish massage (n=3), Western massage (n=2), musculotendinous massage (n=1), ice massage (n=1), or a combination of techniques (e.g., Effleurage, Petrissage, Tapotement, Friction, Vibration) (n=18); (Table 2). Seven of the studies assigned respondents to the no-treatment inactive control group (Huang et al., 2010; Dawson, Dawson, Thomas, & Tiidus, 2011; Lau & Nosaka, 2011; Crane et al., 2012; Boguszewski, SzkodaAdamczyk, & Białoszewski, 2014; White et al., 2020; Zhong et al., 2018). Seventeen studies included an active treatment control group , which included continuing training, sham hip and knee mobilisation, placebo ultrasound, wrestling training, active and passive rest, eccentric exercise, etc. (Guest, 2010; Arroyo-Morales et al., 2011; Pinar et al., 2012; Rasooli, Jahromi, Asadmanesh, & Salesi, 2012; Imtiyaz, Veqar, & Shareef, 2014; Han et al., 2014; Zadkhosh et al., 2015; Shin & Sung, 2015; Nunes et al., 2016; Kargarfard et al., 2016; Kong et al., 2018; Moran et al., 2018; Bender et al., 2019; Kaesaman & Eungpinichpong, 2019; Ambarawati et al., 2021; Alonso-Calvete et al., 2022; Aeini, 2022). Five studies compared massage with other interventions such as static stretching, dynamic stretching, and cold-water immersion (Fletcher, 2010; Delextrat, Calleja-González, Hippocrate, & Clarke, 2013; Imtiyaz et al., 2014; Moran et al., 2018; Fakhro, Chahine, Srour, & Hijazi, 2020). Three trials massage was as a stand-alone treatment (Sharma & Noohu, 2014; Vickcales, 2018; Bayer & Eken, 2021). Treatment periods varied from one session (n=19) to 4 weeks three times a week, for a total of 12 sessions, and the massage session remained for 30 seconds (n=2), 5 minutes (n=1), 7 minutes (n=1), 8 minutes (n=1), 9 minutes (n=1), 10 minutes (n=4), 15 minutes (n=4), 16 minutes (n=1), 20 minutes (n=6), 24 minutes (n =1), 25 minutes (n=1), 30 minutes (n=7), and different durations of 5, 10, and 15 minutes (n=1). The point time after completing the massage varied from immediately after the massage session to 10 days.

Compared with the active control, twelve studies found massage to have a significant and measurable benefit (Arroyo-Morales et al., 2011; Rasooli et al., 2012; Imtiyaz et al., 2014; Han et al., 2014; Zadkhosh et al., 2015; Shin & Sung, 2015; Nunes et al., 2016; Kargarfard et al., 2016; Bender et al., 2019; Kaesaman & Eungpinichpong, 2019; Ambarawati et al., 2021; Aeini, 2022), whereas five studies found no obvious advantage (Guest, 2010; Pinar et al., 2012; Kong et al., 2018; Moran et al., 2018; Alonso-Calvete et al., 2022). Comparing massage to an inactive control, four studies reported massage to have a significant and considerable effect (Huang et al., 2010; Crane et al., 2012; Boguszewski et al., 2014; Zhong et al., 2018), whereas three studies did not (White et al., 2020; Dawson et al., 2011; Lau & Nosaka, 2011). In comparison to other therapies, three studies reported massage to have a measurable and considerable effect (Fletcher, 2010; Delextrat et al., 2013; Imtiyaz et al., 2014), whereas two studies did not (Moran et al., 2018; Fakhro et al., 2020). Massage as a stand-alone treatment provided a considerable and substantial benefit in two studies (Vickcales, 2018; Bayer & Eken, 2021), whereas one study found no significant impact on muscle healing, performance, physiological, and psychological (Sharma & Noohu, 2014).

Table 1. Summary of the methodological quality assessment scores

Author and Year	Eligibility criteria	Random allocation	Concealed allocation	Group similar at baseline	Blind subject	Blind therapist	Blind assessor	Follow-up	Intention-to-treat analysis	Between-group comparisons	Point measure and variability	PEDro score
Guest (2010)	1	1	0	1	0	0	0	1	1	1	1	6
Huang et al. (2010)	1	1	1	1	0	0	0	1	1	1	1	7
Fletcher (2010)	1	1	0	1	0	0	0	1	1	1	1	6
Dawson et al. (2011)	1	1	0	1	0	0	0	1	1	1	1	6
Lau & Nosaka (2011)	1	1	0	1	0	0	0	1	0	1	1	5
Arroyo-Morales et al. (2011)	1	1	0	1	0	0	0	1	1	1	1	6
Pinar et al. (2012)	1	1	0	1	0	0	0	1	1	1	1	6
Crane et al. (2012)	1	1	0	1	0	0	0	1	1	1	1	6
Rasooli et al. (2012)	1	1	0	1	0	0	0	1	1	1	1	6
Delextrat et al. (2013)	1	1	1	1	0	0	0	1	1	1	1	7
Sharma & Noohu (2014)	1	0	0	0	0	0	0	1	0	0	0	0
Imtiyaz et al. (2014)	1	1	1	1	0	0	0	1	1	1	1	7
Han et al. (2014)	1	1	1	1	0	0	0	1	1	1	1	7
Boguszewski et al. (2014)	1	1	0	1	0	0	0	1	1	1	1	6
Zadkhosh et al. (2015)	1	1	0	1	0	0	0	1	1	1	1	6
Shin & Sung (2015)	1	1	0	1	0	0	0	1	1	1	1	6
Hoffman et al. (2016)	1	1	0	1	0	0	0	1	1	1	1	6

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Author and Year	Eligibility criteria	Random allocation	Concealed allocation	Group similar at baseline	Blind subject	Blind therapist	Blind assessor	Follow-up	Intention-to-treat analysis	Between-group comparisons	Point measure and variability	PEDro score
Nunes et al. (2016)	1	1	0	1	0	0	0	1	1	1	1	6
Kargarfard et al. (2016)	1	1	0	1	0	0	0	1	1	1	1	6
Zhong et al. (2018)	1	1	1	1	0	0	0	1	1	1	1	7
Kong et al. (2018)	1	1	0	1	0	0	0	1	1	1	0	5
Vickcales (2018)	1	0	0	0	0	0	0	1	0	0	0	1
Moran et al. (2018)	1	1	0	1	0	0	0	1	1	1	1	6
Bender et al. (2019)	1	1	0	1	0	0	1	1	1	1	1	7
Kaesaman & Eungpinichpong (2019)	1	1	0	1	0	0	0	1	1	1	1	6
Fakhro et al. (2020)	1	1	0	1	0	0	0	1	0	1	1	5
White et al. (2020)	1	1	0	1	0	0	0	1	1	1	1	6
Ambarawati et al. (2021)	1	1	0	1	0	0	0	1	1	1	1	6
Bayer & Eken (2021)	1	1	0	1	0	0	0	1	1	1	1	6
Alonso-Calvete et al. (2022)	1	1	0	1	0	0	1	1	1	1	1	7
Aeini (2022)	1	1	0	1	0	0	0	1	1	1	1	6
Total	31	29	5	29	0	0	2	31	27	29	28	

Table 2. Overview of the included studies (n=31)

Author and Year	Intervention	Massage Technique	Duration	Time Point after Intervention	Outcome Measure	Effect of Massage
Guest (2010)	Massage vs Passive Recovery	Effleurage Petrissage Tapotement Vibration	20 min for 24 h	24, 48 h	Mood State (Profile of Mood States-Standard Questionnaire) Range of Motion (Goniometer) Sports Performance (Vertical Jump Test) Perceived Performance (Plyometric Exercises)	In terms of mental health, athletic ability, and flexibility, no significant differences were observed. The massage group had considerably better perceived performance than the passive recovery group at the 24-h mark
Huang et al. (2010)	Massage vs Control with no treatment	Musculotendinous Massage (friction)	10, 30 s a 1-week period	10, 30 s	Flexibility (Electromyography) Range of Motion Manual Goniometer, Passive Straight Leg Raise Technique, Handheld Dynamometer	Musculotendinous massage for 10–30 s improves hamstring flexibility, tolerance to stretching, and compliance
Fletcher (2010)	Massage vs Massage and Warm-up vs. Traditional Active Warm-up	Effleurage superficial and fast techniques	9 min 3 sessions	Weekly intervals	Sprint Performance (Manual 2-Dimensional Digitising System, 20-m Sprint Performance	Massage tends to lower the 20-m sprint performance relative to a typical warm-up. Therefore, pre-competition massage seems ineffective in improving sprint performance
Dawson et al. (2011)	Massage vs Control with no treatment	Swedish Massage (Petrissage, Effleurage strokes)	30 min 7 of the 10 weekly massages	Weeks 1, 5, and 9	Muscle Strength (CYBEX NORM Dynamometer) Leg Pain at Rest During and after Running (7-Point Pain Scale) Functioning (7-point capability scales) Running Behaviour (9-Point Intensity Scale) Running Confidence	Muscle strength, pain perception, everyday functioning, and running confidence were not improved by regular massage during training
Lau & Nosaka (2011)	Massage vs Control with no treatment	Vibration (Dynamic Tissue Stimulation)	30 min for 5days	30 min, 24, 48, 72, 96, 120, 168 h	Muscle Strength (Isokinetic Dynamometer) Range of Motion (Plastic Goniometer) Pressure –Pain Threshold (Electronic Algometer) Serum Plasma Creatine Kinase Level Activity (Venipuncture Technique) Delayed-Onset Muscle Soreness (Visual Analogy Scale) Circumference Constant-Tension Tape	The effects of vibration massage on edema, muscular strength recovery, or serum creatine kinase activity were not observed. However, vibration massage was beneficial in reducing delayed-onset muscle soreness and restoring range of motion

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Table 2. Overview of the included studies (n=31)

Author and Year	Intervention	Massage Technique	Duration	Time Point after Intervention	Outcome Measure	Effect of Massage
Arroyo-Morales et al. (2011)	Massage vs Sham Ultrasound	Effleurage Petrissage Tapotement	20 min	10 min	Mood States Tension Anxiety Depression Dejection Anger Hostility Vigour Fatigue Confusion (Profile of Mood States Questionnaire) Muscle Performance (Isokinetic Dynamometry)	Muscle performance was significantly impacted by pre-massage massage, as measured by lower isokinetic peak torque at higher speeds. Neither the content of cortisol in the saliva nor the activity of a-amylase changed noticeably. There was a notable increase in the mechanical detection thresholds at both sites after the massage intervention. The tension subscale of the profile of mood states was significantly lower following massage than placebo
Pinar et al. (2012)	Massage vs Electrical Muscle Stimulation vs Passive Rest	Stroking Effleurage Kneading picking up wringing rolling	24 min	After the session immediately	Perceived Exertion (Borg Scale) Recovery (Total Quality of Recovery Scale) Blood Lactate (Scout Lactate Analyser)	Physiological and psychological recovery after intense exercise was not affected by massage
Crane et al. (2012)	Massage vs Control with no treatment	Effleurage Stroking Petrissage	10 min	2.5 h	Muscle Damage (Muscle Biopsies)	Clinical evidence suggests that massage treatment is helpful, in part because it decreases inflammation and boosts mitochondrial biogenesis
Rasooli et al. (2012)	Massage vs Active Recovery vs Passive Recovery	Sport Massage (Effleurage, Petrissage, Tapotement, Compression)	10 min 3 times over a period of 3 weeks	24, 48, 72 hours	Blood Lactate (Accoutred Portable Lactate Analyser) Performance Endurance (Sprint 200 m Swimming)	Compared with passive recovery, massage was more successful in removing blood lactate. Active and massage recovery were more effective than passive recovery in enhancing swimming performance
Delextrat et al. (2013)	Massage vs Cold-Water Immersion or Control	Western Massage (Effleurage, Petrissage)	30 min	0, 24 h	Fatigue (Visual Analogue Scale) Recovery Physical Performance (Countermovement Jump Test) Repeated-Sprint Ability Test	Massage increased psychological markers of recovery but had little effect on repeated sprint performance or jumping ability
Sharma & Noohu (2014)	Massage	Ice Massage	5 min	After the session immediately	Weight Discrimination Ability (Weight Discrimination Ability Testing) Functional Performance Functional Performance Tests Single Hop Test Crossover Hop Test)	Hamstring (biceps femoris) proprioception is relatively unaffected by ice massage of the tendon (biceps femoris)

Imtiyaz et al. (2014)	Massage vs Vibration Therapy vs Control before Eccentric Exercise	Stroke	15 min	24, 48, 72 hours	Muscle Soreness (Visual Analog Scale) Range of Motion (Goniometer) Maximum isometric force (Mounted on a Wall) Repetition Maximum (Lift a Certain Weight Once) Creatine Kinase Leve (Creatine Kinase Test)	Massage is beneficial for preventing delayed-onset muscle soreness and restoring concentric strength (1 RM)
Han et al. (2014)	Massage vs Control with TENS Equipment Pad	Light Stroking Milking Friction Skin Rolling	15 min	After the session immediately	Delayed Onset Muscle Soreness (Commander Algometer) Gait (Gaitrite Electronic Walkway)	Delayed-onset muscular soreness can be alleviated by massage, which in turn affects both pain and gait speed
Boguszewski et al. (2014)	Massage vs Control with no treatment	Sport Massage (Sliding, Effleurage, Rubbing, Kneading, Vibration)	20 min	24, 48,72,96 hours	Muscle Soreness (Visual Analogue Scale) Exercise Intensity (Borg Rating of Perceived Exertion Scale) Jump Performance (Friedman Test with Post hoc Testing) Lower Limb Power (Vertical Jump Test)	Massage may be a useful treatment for muscular discomfort because it speeds up healing and enhances muscle performance after exercise
Zadkhosh et al. (2015)	Massage vs Control with Wrestling Training	Sports Massage (Effleurage, Petrissage, Tapotement, Friction, Vibration)	25 min 10 sessions for 10 days	10 days	Depression Anxiety Stress (Depression Anxiety and Stress Scale)	Massage has been shown to have a measurable and substantial effect on reducing depression, anxiety, and stress in wrestlers, which in turn has been shown to improve the mental health and performance of the athletes
Shin & Sung (2015)	Massage vs Control received An Attached Transcutaneous Electrical Nerve Stimulation Pad	Light Stroking Milking Friction Skin Rolling	15 min	After the session of massage immediately	Muscle Activity (Sonography Surface Electromyography) Proprioception Lactate (Dual Inclinometer Lactate Pro Analyser)	Massage of the gastrocnemius can increase muscular strength and proprioception by affecting the superficial layer of the muscle
Hoffman et al. (2016)	Massage vs Control with no treatment	Effleurage Compression Tapotement	20 min	after the completion of a 161-km ultramarathon and 7 days following Postrace	Perceived Fatigue Pain (Plasma Creatine Kinase)	When compared with the control group, those who received massage reported much less fatigue and pain

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Table 2. Overview of the included studies (n=31)

Author and Year	Intervention	Massage Technique	Duration	Time Point after Intervention	Outcome Measure	Effect of Massage
Nunes et al. (2016)	Massage vs Control Resting in Sitting	Effleurage Petrissage Tapotement	7 min	After the session of massage immediately	Pain Perceived Fatigue (Visual Analogue Scale, Pressure Pain Threshold, Digital Pressure Algometry)	Subjective reports of pain and fatigue were reduced after the massage, but there was no change in the pain threshold to pressure
Kargarfard et al. (2016)	Massage vs Control with Passive Recovery	Western Massage (Effleurage, Petrissage, Vibration)	30 min for 72 h	24, 48, 72 hours	Plasma Creatine Kinase (Standard Venipuncture Technique) Muscle Soreness Rating (Visual Analogue Scale) Perceived Soreness Levels Agility (Agility Test) Vertical Jump (Vertical Jump Test) Maximum Isometric Torque (Isokinetic Dynamometer)	It has been shown that receiving a massage after strenuous exercise might speed up the recuperation process and increase performance
Zhong et al. (2018)	Massage vs Control with no treatment	Mechanical-Bed Massage (Pangguang Jing)	20 min	24 h	Fatigue (Visual Analogue Scale) Endurance (Heart Rate Variability Back Muscle Endurance)	Bed massage may assist athletes overcome exercise-induced weariness and balance sympathetic and parasympathetic activity. Bed massage may reduce muscular and central weariness after training or competition
Kong et al. (2018)	Massage vs Ultrasound	Swedish Massage (Effleurage, Wringing, Kneading, Tapotement)	16 min	24, 48,72,96 hours	Muscle Stiffness (Hand-Held Myotonometry Device) Perceived Muscle Soreness (11-Point Numerical Rating Scale) Plasma Creatine Kinase (Biochemical Marker of Muscle Damage)	Changes in major leg muscle stiffness were not improved by massage
Vickcales (2018)	Massage	Primal Reflex Release	15 to 20 min for 72 h	48, 72 h	Stress and Anxiety Heart Rate (State Trait Anxiety Inventory) Blood Pressure (Pulse Oximeter) Pain (Numeric Pain Rating Scale)	Reducing stress and anxiety with the help of the primal reflex release technique is possible right away

Moran et al. (2018)	Pre-Competition Massage vs Traditional Warm-up vs Combination of Massage and Traditional Warm-up vs Placebo Ultrasound	Effleurage Petrissage Tapotement Circular Friction Jostle	10 to 15 min	48 h	Acceleration and sprint performance (20-metre and 30-metre acceleration and 76 & 60-metre Sprint Performance)	There is no evidence that massage improves sprinting performance or accelerating abilities more than other therapies
Bender et al. (2019)	Massage vs Control with Sham Hip and Knee Mobilisation	Effleurage Petrissage	10 min	0, 24, 48, and 72 h	Pain and Perceived Fatigue (Numerical Rating Scale, McGill Pain Questionnaire) Pain Behaviour (Mobile Phone App) Mood Profile (Brunel Mood Scale) Flexibility Jump Performance Isometric Strength (Hand-Held Dynamometer)	Although massage helped lessen the severity of the pain, the improvement was marginal at best. Perceived weariness, flexibility, strength, and jumping ability were not significantly affected
Kaesaman & Eungpinichpong (2019)	Massage vs Control with Passive Rest	Traditional Thai Massage (Effleurage)	10 min	0, 72 h	Heart Rate Variability Physical Fitness (Sit and reach test) Grip Strength (Grip Dynamometer) Strength (Back-Leg-Chest Dynamometer)	There is a more immediate effect of Thai traditional massage on recovery, making it a viable method for restoring muscular function and enhancing athletic performance
Fakhro et al. (2020)	Massage vs Static Stretching vs Dynamic Stretching	Deep Transverse Friction	30 seconds 4 weeks three times a week for 12 sessions	4 weeks	Flexibility Agility Strength (Straight Leg Raises, Maximum Tests, T-Drill Test)	When compared with static and dynamic techniques, the effects of massage on soccer performance did not outweigh those of static and dynamic techniques
White et al. (2020)	Massage vs Control with no treatment	Effleurage	30 min	1, 2, 24 h	Muscle Soreness (Likert Scale) Muscle Function (Squat and Drop Jump)	Performance and measures of muscle pain were not improved after massage. Inflammation caused by physical exertion may be alleviated by massage

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Table 2. Overview of the included studies (n=31)

Author and Year	Intervention	Massage Technique	Duration	Time Point after Intervention	Outcome Measure	Effect of Massage
Ambarawati et al. (2021)	There was a 3-day interval between the first treatment (Massage) and the second (Active Resting)	Sport Massage	30 min	4 days	Fatigue Lactic Acid (Accurted Lactate)	When it comes to lowering lactic acid levels, sport massage is superior to active resting
Bayer & Eken (2021)	Massage	Swedish Massage (Effleurage, Friction, Petrissage, Pressing)	5, 10, 15 min for 24 h	5, 10, 15 min	Jump (Counter Movement Jump) Squat Jump Sitting and Lying Flexibility (Squat Jump Sit and Flexibility	Massage durations had favorable impacts on flexibility, squat jump, and counter movement jump performances
Alonso-Calvete et al. (2022)	Massage vs Passive Recovery	Sport Massage (Percussive massage with a gun)	8 min	24 h	Perceived Fatigue (Rating Perceived Exertion Scale) Blood Lactate (Capillary Device)	Percussive massage does not appear to aid recovery
Aeini (2022)	Massage vs Control, with both groups continuing training	Aromatherapy Massage (Effleurage, Tapotement, Friction, Petrissage)	30 min 12 sessions in two weeks	2 weeks	Fatigue (Rating of Perceived Exertion) Mood (Mood Questionnaire)	Massage can alleviate fatigue and improve mood

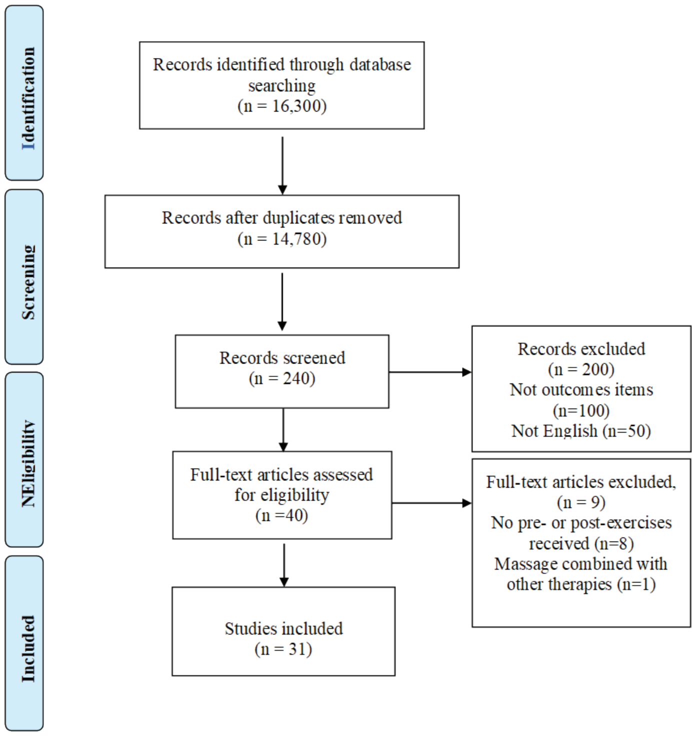

FIGURE 1. PRISMA flow chart for systematic review of studies

Discussion

In summary, the body of research on the effects of massage reveals a nuanced picture. Most studies suggest that massage provides a significant and measurable benefit compared with active control, demonstrating its potential positive influence on muscle recovery and performance across various contexts (Arroyo-Morales et al., 2011; Rasooli et al., 2012; Han et al., 2014; Imtiyaz et al., 2014; Shin & Sung, 2015; Zadkhosh et al., 2015; Kargarfard et al., 2016; Nunes et al., 2016; Kaesaman & Eungpinichpong, 2019; Bender et al., 2019; Ambarawati et al., 2021; Aeini, 2022).

However, a notable subset of studies contradicts these findings, reporting no discernible advantage of massage (Guest, 2010; Pinar et al., 2012; Kong et al., 2018; Moran et al., 2018; Alonso-Calvete et al., 2022). When contrasted with inactive control, several studies emphasise the efficacy of massage, showcasing significant and considerable effects (Huang et al., 2010; Crane et al., 2012; Boguszewski et al., 2014; Zhong et al., 2018). Conversely, another set of studies fails to find such an impact, indicating variability in outcomes (Dawson et al., 2011; Lau & Nosaka, 2011; White et al., 2020).

In the realm of comparisons with other therapies, the evidence is mixed. Some studies report measurable and considerable effects of massage, aligning with its potential as a therapeutic intervention (Fletcher, 2010; Delextrat et al., 2013; Imtiyaz et al., 2014), whereas others do not observe such benefits (Moran et al., 2018; Fakhro et al., 2020). As a stand-alone treatment, some studies indicate considerable and substantial benefits (Vickcales, 2018; Bayer & Eken, 2021), but a divergent view exists, with one study showing no significant impact on various aspects (Sharma & Noohu, 2014).

Furthermore, Rasooli et al. (2012) discovered that massage is more effective than passive recovery in eliminating blood lactate. Active and massage recovery were more successful in improving swimming performance than passive recovery; various studies have shown that massage promotes more blood lactate removal than passive recovery (Herbert et al., 2012). The subjects and procedures of the study by Rasooli et al. (2012) were comparable to those of Greenwood et al. (2008), which validates these findings. Findings of certain research did not confirm the findings of Rasooli et al. (2012) and revealed that there was no change between blood lactate levels following massage and active recovery (Weerapong et al., 2005).

While the study by Bender et al. (2019) suggested that massage had a minimal effect in reducing discomfort and found no statistically significant changes in fatigue, flexibility, strength, or leaping ability, the findings are contradicted by Shin and Sung (2015) and Nunes et al. (2016), who argued that massage had a positive impact on outcomes. In addition, Hopper et al. (2005) reported a positive effect of massage on hamstring flexibility in ice hockey players, and Shin and Sung (2015) observed increased ankle plantar flexion strength in healthy individuals after receiving massage following eccentric activity. The varied effects of massage were further highlighted in the context of recovery for different activities, such as volleyball players experiencing a boost in vertical leap after receiving massage and runners showing a decline in physiological and physical performance after a 10k run (Mancinelli et al., 2006). This suggests that the effectiveness of massage may be context-dependent and not universally applicable to all forms of recovery.

Kargarfard et al. (2016) suggested that receiving a massage after strenuous exercise may expedite the recovery process and enhance performance. This finding aligns with the research of Delextrat et al. (2013), who demonstrated that 6–15 min of petrissage massage could increase muscular strength and performance. In contrast, Behm and Colado (2012) reported that reduced muscle strength might persist for approximately a month despite exercise. Filipa et al. (2010) found that after eight weeks of exercise, massage had no effect on muscle performance. In another context, Nunes et al. (2016) observed that a brief quadriceps massage reduced pain and subjective exhaustion in individuals who had just completed a 226-kilometer Ironman race. This observation is consistent with the notion that the beneficial effects of massage on perceived fatigue may be linked to increased localised blood circulation, aiding in the removal of metabolic waste (Weerapong et al., 2005; Hennenfent et al., 2006; Best et al., 2008; Wiltshire et al., 2010; Portillo-Soto et al., 2014).

The study by Bayer and Eken (2021) indicated that massage durations have positive effects on counter movement jump performance, squat jump, and flexibility, consistent with similar findings in studies exploring the influence of massage before exercise or competition. Several studies have supported the idea that massage stimulates the neurological system and increases muscle suppleness and performance (Nelson & Kokkonen, 2001; McHugh & Cosgrave, 2010). Sykaras et al. (2003) examined the effect of a 2-min massage on knee extensor peak torque among Taekwondo players and found positive outcomes. Additionally, Brooks et al. (2005) discovered that grip performance significantly improved with a 5-min manual forearm massage, and Farr et al. (2002) determined that muscle strength increased after 40 min of downhill treadmill walking followed by 30 min of massage. These studies collectively highlight the potential positive impact of massage on various aspects of physical performance.

Shin and Sung (2015) demonstrated that gastrocnemius massage can enhance muscular strength and proprioception, consistent with Jakeman et al. (2010), who found that massage prevents the loss of muscle strength. However, Zainuddin et al. (2005) contradicted these findings, suggesting that massage has no substantial protective effect on muscle strength loss, attributed to inadequate blood flow for tissue healing. Moraska (2005) indicated that a successful massage should last at least 10 min in each body area, and Butterfield et al. (2008) highlighted the significance of factors such as timing, length of massage, massage type, and exercise-damaging regimens in determining effectiveness. Davis et al. (2020) emphasised that differences in massage length and technique may lead to contradictory effects on muscle activity.

In contrast, White et al. (2020) asserted that massage did not improve the measures and performance of muscle discomfort, contradicting the potential alleviation of inflammation caused by physical activity. This is consistent with the findings of Nédélec et al. (2013), who found no significant difference between the massage and control legs in terms of isometric and dynamic peak torques up to 96 h after exercise, suggesting that massage may not be helpful in the short term for restoring muscle function. Moran et al. (2018) also found no evidence that massage improved sprinting performance or acceleration abilities more than other therapies, consistent with the results of Goodwin et al. (2007), who observed no significant effects on sprint performance. These studies collectively suggest a divergence in the effectiveness of massage across different measures and contexts.

Pinar et al. (2012) reported that massage had no significant effect on recovery from a psychological and physiological perspective after strenuous exercise. This finding contrasts with the positive impact of electrical muscle stimulation on the activation rate of motor units, which may aid in the healing of injured patients, as suggested by Smith et al. (2003). However, conflicting evidence exists, as Lattier et al. (2004) found no meaningful benefit of electrical muscle stimulation in post-recovery performance. Martin et al. (2004) reported a negative effect on post-recovery anaerobic exercise performance and maximal voluntary contraction force, whereas Cortis et al. (2010) found no meaningful influence on physiological markers of submaximal aerobic performance. In a sport-specific rock-climbing test, Heyman et al. (2009) revealed that electrical muscle stimulation was more damaging to performance than active recovery.

On the other hand, Zadkhosh et al. (2015) demonstrated that massage has a measurable and substantial effect on reducing depression, anxiety, and stress in wrestlers, leading to improved mental health and performance. These findings align with Noto et al. (2007), who also found that physical contact during massage can alleviate anxiety and improve psychological well-being. Hemmings (2001) categorised the impacts of massage into three categories: performance, psychological, and physiological, noting an improvement in temperament as one of the psychological effects. Aeini (2022) further supported the psychological benefits of massage, suggesting that it could alleviate weariness and improve emotions, consistent to some degree with the findings of Sherman et al. (2009).

Arroyo-Morales et al. (2011) reported that pre-massage significantly affected muscle performance, leading to a decline in isokinetic peak torque at higher speeds. However, salivary cortisol levels and alpha-amylase activity did not significantly change. After the massage, mechanical detection thresholds increased significantly, and the tension subscale of the Profile of Mood States was considerably reduced compared with the placebo. This reduction in tension is associated with improved athletic performance, despite a decrease in vigour, as observed in a previous study (Arroyo-Morales et al., 2008). The findings align with research indicating that decreased stress has a favourable impact on performance, consistent with other studies on the psychological effects of massage, such as Szabo et al. (2008). It is noteworthy that the beneficial effect of massage on emotional state is particularly evident in short-duration, open-skill, individual sports, emphasising the potential recommendation of pre-event massage for athletes prone to pre-event tension (Beedie et al., 2000).

Limitations of the Study

This study has several notable limitations. First, the research exhibits a heterogeneous quality, encompassing both high- and low-quality investigations, as denoted by the PEDro scale, where two studies scored below the threshold of 5. A complete absence of subject or therapist blinding was observed across all scrutinised studies, coupled with a prevailing lack of a blind assessor in most cases, thereby potentially compromising the reliability of the obtained results. The study's comprehensive consideration of diverse massage methods, marked by variations in frequency, duration, and techniques, introduces a substantial degree of heterogeneity, thereby complicating the formulation of specific conclusions regarding the optimal approach to massage. Furthermore, the study concedes to a restricted evaluation of massage efficiency, thereby highlighting a discernible gap in comprehending the precise conditions that render massage the most effective. Additionally, the predominantly athletic composition of participants in the analysed studies imposes constraints on the generalisability of findings to the broader population. Finally, the absence of uniformity in treatment durations, spanning from single sessions to four weeks three times weekly, poses a formidable challenge in determining the optimal temporal parameters for achieving the desired effects.

Strengths and Implications of the Study

This study is distinguished by several commendable characteristics. First, it is underpinned by a substantial dataset meticulously assembled through an exhaustive review of 31 studies, thereby contributing to a robust analytical framework. The deliberate inclusion of diverse massage methods and systematic comparisons with disparate controls enriches the breadth and depth of the study findings. The study's global representation, characterised by the inclusion of research from varied countries, imparts a comprehensive perspective on the effects of massage therapy, thereby augmenting the generalisability of the derived conclusions. Furthermore, the methodological quality of the study is subjected to rigorous scrutiny through a critical analysis using the PEDro scale, a practice that contributes transparency to the overall review process.

Moreover, the study exhibits a commendable feature in its capacity to identify notable research lacunae. Specifically, it underscores the imperative for a more thorough evaluation of massage efficiency and the establishment of standardised treatment parameters. Finally, the study holds practical significance for athletes, positing discernible advantages stemming from massage therapy in the realms of muscle recovery and performance. Consequently, it provides valuable insights to sports professionals and athletes, steering them toward evidence-based strategies for enhancing training outcomes.

In summary, while the observed benefits of massage therapy in terms of muscle recovery and performance compared with controls are noteworthy, the study underscores the imperative for heightened standardisation of research methodologies and treatment parameters. In addition, a deeper understanding of the underlying mechanisms governing the efficacy of massage is advocated to enhance the credibility and applicability of the findings.

Conclusion

The study asserts that massage therapy manifests a substantial and noteworthy advantage in fostering muscle recovery, promoting physiological and psychological well-being, and enhancing athletic performance compared with both inactive and active controls. Nonetheless, when compared against alternative interventions, the evidence reveals a confluence of outcomes, thereby introducing a conflicting pattern of results with conflicting implications. Moreover, when implemented as an independent treatment modality, massage shows a significant benefit in specific studies; however, a divergence of evidence surfaces concerning its influence on aspects such as muscle healing, performance, physiological and psychological aspects.

Author Contributions:

QG and MA performed the literature search, selection of studies, and study quality assessment. Following an initial screening of titles and abstracts (QG and MA), full scrutiny of potentially eligible studies was independently screened by QG and AR using specific inclusion criteria. MA arbitrated any disagreements in study inclusion. All authors contributed to the revision of the manuscript and have read and approved the final version of the manuscript.

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Conflicts of interest:

The authors have no conflicts of interest to declare.

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